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THE MNEMIC THEORY OF HEREDITY.

Die Mneme als erhaltendes Prinzip in Wechsel des Organischen Geschehens. By R. Semon. Dritte Auflage. Pp. xviii+420. (Leipzig: W. Engelmann, 1911.) Price 10 marks.

THE theory of heredity which is associated more especially with the names of Ewald Hering, Samuel Butler, and Richard Semon, and endeavours to explain the phenomena of inheritance as due to a kind of unconscious memory, on the part of the developing organism, of the experiences of past generations, has not, at any rate in this country, met with a very large measure of acceptance. It is a noteworthy fact, however, that in 1908 Mr. Francis Darwin made it the subject of his presidential address to the British Association at Dublin, and expressed views which correspond very closely with those of the authors mentioned.

The mnemic theory, which is based upon a belief in the inheritance of acquired characters, naturally does not appeal to those who deny the possibility of such inheritance. The position taken up with regard to this question by Prof. Weismann and his followers, however, can scarcely be maintained much longer in face of the rapidly accumulating evidence which, it must be confessed, their unbelief has been perhaps the chief agent in eliciting.

Prof. Semon quotes several instances of this evidence in the work before us, the most convincing of which appears to be that obtained by M. E. Bordage in the case of peach trees. It has long been known that European trees, when grown in tropical or semi-tropical countries, tend to lose their deciduous character and become evergreen. This is the case in the Island of Réunion, where M. Bordage conducted his experiments. He found that in the course of twenty years peach trees imported from Europe become almost completely evergreen. This, of course, is an individual somatogenic, or so-called "acquired" character; but when seeds of these modified trees are sown in certain mountain districts where they are exposed to a considerable amount of frost, they produce young peach trees which are also evergreen, although seeds imported from Europe and sown in similar situations produce normal deciduous trees.

It is true that an attempt has been made with regard to such cases to uphold the Weismannian position by suggesting that the stimulus of changed environment affects both the somatic cells and the germ cells of the parent simultaneously, by what is called "parallel induction," so that the germ cells are modified in a corresponding fashion to the somatic cells, and will therefore give rise to similarly modified offspring; but this certainly looks very like a last attempt to maintain an untenable position, and, in any case, as Sumner and Semon have pointed out, it makes no difference as regards the importance of the action of the environment as a factor in organic evolution whether we suppose the effect upon the germ cells to be produced by "parallel" or by "somatic induction."

The mnemic theory assumes that the germ cells are not, as Weismann would have us believe, shut off from the influence of the body or soma, but that they are, like other cells, and more especially the nerve cells, capable of responding to stimuli by some definite alteration in their condition. The stimuli to which they respond are changes in what Semon calls the "energetic situation" of the whole organism. The effects of such changes are supposed to be impressed upon the germ cells as "engrams," and are of a lasting character.

We may here translate Semon's two mnemic "laws" ("Hauptsätze"):—

First Mnemic Law (*Law of Engraphy*).—All simultaneously acting stimuli within an organism form a coherent simultaneous stimulation-complex, which acts engraphically as such, *i.e.* which leaves behind a coherent and to that extent a unified engram-complex.

Second Mnemic Law (*Law of Ekphory*).—The partial recurrence of the energetic situation, which has previously acted engraphically, acts ekphorically upon a simultaneous engram-complex. To speak more precisely: the partial recurrence of the stimulation-complex which left behind it the engram-complex acts ekphorically upon a simultaneous engram-complex, whether it be a recurrence in the form of the original stimuli or of mnemic stimuli.

It is perhaps scarcely necessary to point out that by "Ekphorie" Semon means the calling forth again of the latent engrams by some appropriate stimulus, whereby they become manifested in the organism.

The condition of the germ cells is thus supposed to be more or less permanently modified by changes in the "energetic situation" of the parent body, and such modifications affect the development of the germ cells because the engrams are called forth in due sequence by appropriate stimuli and express themselves in corresponding modifications of the body of the offspring

The germ cells are thus stored with the latent "memories" of past generations, and they may contain many engrams that may never get the chance to express themselves in any particular individual ontogeny. Thus a number of alternative routes are open to each individual at the commencement of its life-history, and the particular route followed will depend upon the nature of the stimuli which the developing organism happens to encounter.

Semon finds confirmation of these views in the experiments of Kammerer upon the toad, *Alytes obstetricans.* It is well known that most frogs and toads deposit their eggs in water, where the male embraces the female and squeezes the eggs from her by the pressure of his arms. As the eggs pass out they are fertilised, their gelatinous envelopes swell up, and they adhere together to form the spawn. In adaptation to this habit the forefinger of the male exhibits a characteristic pad or swelling, and the musculature of the forearm is hypertrophied.

In the obstetric toad, on the other hand, sexual union, followed by the fertilisation and deposition of the eggs, takes place on land. The eggs are larger and contain more yolk, and are produced in much smaller numbers. The male assists in the removal of the eggs from the female by means of his hind

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legs, and as there is no water to cause the gelatinous envelopes to swell up, they remain sticky and adhere to his legs. No pads are developed on the forefingers, at any rate in the race with which the experiments were made. Thus these toads have departed widely from the ancestral habits of the Anura, but Kammerer discovered that they could be made to return to those habits in a very simple manner by environmental stimuli.

If the animals are kept at a relatively high temperature (25—30° C.) they are induced to seek the water in order to cool themselves, and there the processes of egg-laying and fertilisation take place. The gelatinous envelopes of the eggs now swell up and refuse to adhere to the legs of the male, and the spawn is accordingly left to take care of itself in the water. The animals become gradually accustomed, during several breeding periods, to this altered mode of procedure, and will at length behave in the same way even at the normal temperature. At the same time, the number of eggs which they lay increases and the eggs become smaller and poorer in yolk, and therefore more like those of ordinary frogs and toads.

More important, however, is the fact that the offspring of these toads are found to be modified in their habits exactly as the parents were. When sexually mature they seek the water, even when kept at the normal temperature, and there unite and deposit their eggs. Still more remarkable is the fact that in the fourth generation of the offspring of these modified toads, kept under the same conditions as the parents, the secondary sexual characters found in frogs and toads which normally lay their eggs in water, and which doubtless occurred also in the ancestors of the obstetric toad, are seen to have reappeared; pads are present on the forefingers of the male, and the musculature of the forearm is hypertrophied. Here, then, we have a case of atavism or reversion brought about by changed environment, and in which crossing or hybridisation has played no part. The ancestral engrams must be latent in the germ cells, and capable of being called forth by the recurrence of the appropriate stimuli; unless, indeed, we suppose that the characters in question have been produced altogether *de novo* by the changed environmental conditions, which seems highly improbable in so short a time.

As regards what we may perhaps call the physico-chemical nature of the engrams, Semon adopts a very cautious attitude. Apparently he objects to the idea of material primordia in the germ cells, and purposely avoids molecular interpretations; but he leaves this question entirely open, except in so far as he regards the engrams as being localised, chiefly, if not exclusively, in the nuclei of the germ cells. He also does not attempt to solve the question as to how the necessary stimuli reach the germ cells. That they do reach them, however, appears to be certain from experimental evidence, and that fact is sufficient as a basis for the mnemic theory of heredity.

The fact that this extremely interesting book has now reached its third edition, having been first published in 1904, affords a sufficient indication of the interest which is taken in Germany in the views so ably expressed by its author. ARTHUR DENDY.

BOY LABOUR AND APPRENTICESHIP.

Boy Labour and Apprenticeship. By Reginald A. Bray. Pp. xi+248. (London: Constable and Co., Ltd., 1911.) Price 5*s*. net.

QUESTIONS relating to industrial administration and regulation are of special interest in a time of widespread unrest in the working community. A marked improvement in trade has followed a long period of depression. A book on boy labour therefore arrives opportunely. The present production is interesting rather as a representation of the points of view of a London County Councillor than as an aid to the solution of the problems connected with the entry of the adolescent into the working community.

To deal in a book with these problems it is necessary to begin with a clear definition of the problems and to discuss them with direct reference to an actual issue. Mr. Bray recognises this necessity, but he has not escaped from the confusion of ideas which is too common where social problems are the subject, and his proposals for reform are definite only in the form of words in which they are embodied, but are hopelessly too vague to form a basis for any procedure. The confusion begins in the first chapter, on "The Essentials of Apprenticeship." It is stated that an apprenticeship system must satisfy three conditions. First, it must provide for the adequate supervision of the boys until they reach the age of eighteen; secondly, it must offer full opportunities of training, both general and special—the training of the citizen and the training of the worker; lastly, it must lead forward to some opening in the ranks of adult labour, for which definite preparation has been made, and in which good character may find reasonable prospects of permanent employment.

These requirements are followed by a general demand that they are to be applied to all boys; apprenticeship must be universal. How these essentials are to be assured is admitted to controversy, but that they ought to be assured is taken as axiomatic. Now if these essentials and their universal application to all boys are to be admitted, clearly they must not be specifically associated with preparation for industrial efficiency of workers, but applied to all classes of the community, and in this sense in a general way the propositions will not be disputed as a pious expression of desirable possibilities.

If suitable supervision can be provided, most people would be the better for it even after the age of eighteen. All training is good. A job of some kind for everybody is devoutly to be wished. But in proceeding to examine what the author calls the old apprenticeship system, he gets off at a tangent from his definition, forgets that he is dealing only with a very small number of the boys who lived in the time of trade guilds, and that the arrangements which he praises lacked the quality of universality, which lack vitiates the comparison which he proposes between the good old times and the present.

The summary of methods of apprenticeship, not in the sense defined in the first chapter, but in the sense of specific contract between employer and employed with mutual obligations, is interesting, but is marred

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